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TWO SPECIES OF SPIRURID NEMATODES (NEMATODA, SPIRURIDA) FROM RAPTORS IN BEIJING, CHINA

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Abstract Two species of spirurid nematodes were collected from raptor in Beijing, China. They were examined by light microscopy and scanning electron microscopy (SEM). *Paraspiralatus beijingensis* sp. nov. (Spirurida, Spirocercidae) was recovered from the buccal cavity and stomach of northern eagle owl, *Bubo bubo* (Linnaeus). It differs from *P. sakeri* Gibbons, Nicholls, Bailey and Samour, 2004 in having single median papilla anterior to the cloaca, and in the shape of the right spicule (right spicule with bent and expanded distal end in the new species instead of right spicule with straight and bluntly pointed distal end in *P. sakeri*). *Aprocta noctuae* Spaul, 1927 (Spirurida, Aproctidae) was collected from the body cavity of common scops owl, *Otus scops* (Linnaeus). The morphology of present specimens, including the length and shape of spicules, the number and pattern of caudal papillae in male and the position of vulva opening, the morphology of eggs in female, agree with the description of previous report, but SEM observation revealed 8 cephalic papillae instead of 4 cephalic papillae, and the cuticle of body with fine transverse striations which was considered as a feature of specific importance in taxonomy of genus *Aprocta*. *A. noctuae* is the first record from China.

Key words Raptor, Nematode, *Paraspiralatus*, *Aprocta*, new species.

1 Introduction

Raptors consist of two groups: Falconiformes and Strigiformes. They widely distributed around the world except Antarctica, playing an important role in food chain. In recent years, the quantity of raptors has sharply decreased due to human capture and habitat destruction. All raptors are listed as protected birds in China.

As important group of parasites from raptors, spirurid nematodes in China have been studied by different authors (Schwartz, 1926; Hoeppli *et al.*, 1929; Chu, 1931; Li, 1934; Yamaguti, 1935, 1941a; Hsu, 1957a, 1957b, 1963; Wang, 1965, 1966, Shen and Wu, 1964, 1973; Schmidt and Kuntz, 1972; Zhang, 1991; Zhang *et al.*, 2005). To date, about 38 species of spirurid nematodes has been reported from raptors in China.

Beijing Raptor Rescue Centre was opened on 14 Dec. 2001. It is a joint project of IFAW and Beijing Normal University. Between Dec. 2001 and Mar. 2004, a survey of nematode parasites of raptors was made by the examination of some dead birds. In the survey, one new species and one new record species of spirurid nematodes were collected, and described herein.

2 Materials and Methods

In 2004, some dead raptors were examined for parasites at the Beijing Raptor Rescue Center, Beijing Normal University, Beijing, China. Nematodes were collected from different organs of birds. After washing in physiological saline, the specimens were fixed in hot 70 % ethanol, and then preserved in 70 % ethanol. For light microscopy examination, nematodes were cleared in lactophenol. Drawings were made with the aid of Nikon microscope drawing attachment. For scanning electron microscopy (SEM) studies, specimens were fixed in 4 % formaldehyde, post-fixed in 1 % OsO_4, dehydrated through an ethanol series and acetone, and then subjected to critical point drying. The specimens were coated with gold and examined with a Hitachi S-570 scanning electron microscope at an accelerating voltage of 15 KV. Measurements (minimum, maximum, followed by mean in parentheses) are given in micrometers, unless otherwise stated. Specimens have been deposited in the College of Life Sciences, Hebei Normal University (HBNU), Hebei Province, China.

3 Descriptions

Order Spirurida Diesing, 1861
Superfamily Spiruroidea Orley, 1885
Family Spirocerdiae Chitwood and Wehr, 1932
Genus *Parasporalatus* Gibbons, Nicholls, Bailey and Samour, 2004

3.1 *Paraspiralatus bejingensis* sp. nov. (Figs 1 - 14)

General. Body cylindrical, whitish, with distinct transverse striations. Cephalic vesicle absent. Labial region consisting of 2 pseudolabia, 3 small teeth on

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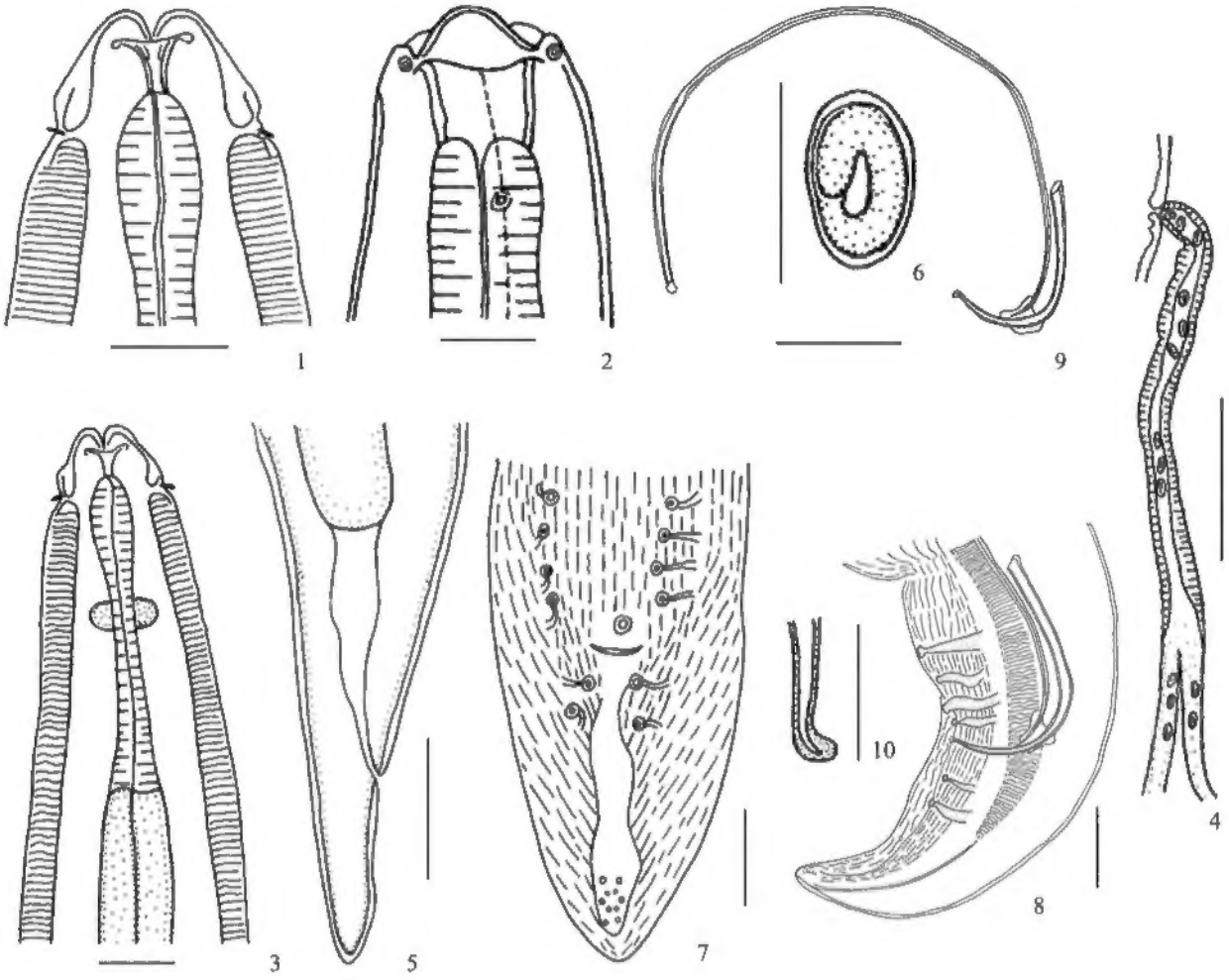
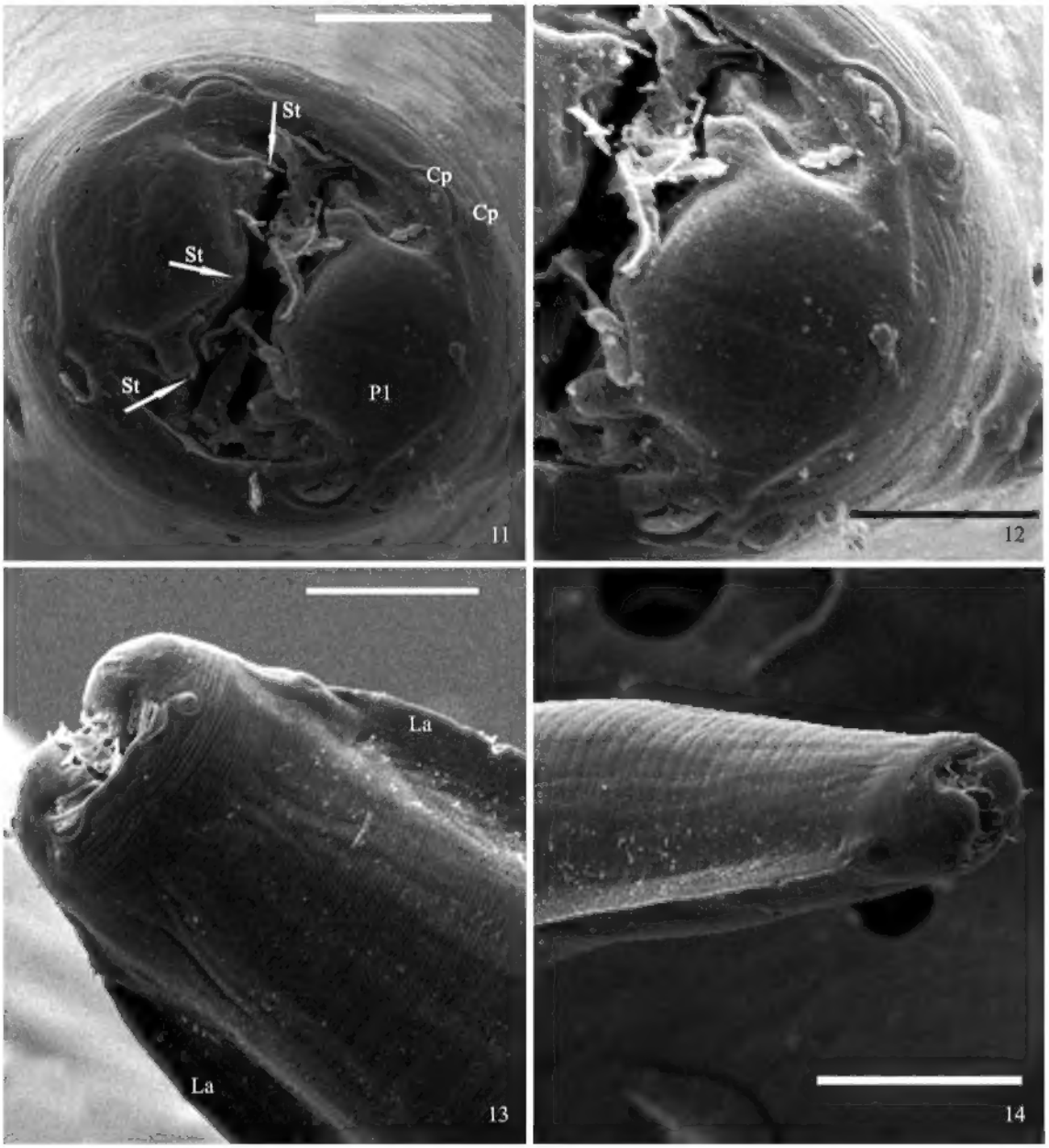


Figs 1 – 10. *Paraspiralatus sakeri* Gibbons, Nicholls & Bailey 2004. 1. Cephalic end of male. 2. Anterior end of male. 3. Anterior end of male. 4. Female vulvar region. 5. Posterior end of female. 6. Egg. 7. Posterior end of male. 8. Posterior end of male. 9. Spicules and gubernaculum. 10. Distal end of right spicule. 1, 7. Ventral view. 2, 4 – 5, 8 – 9. Lateral view. 3. Dorsal view. Scale bars: 1, 3, 7 – 8 = 0.1 mm; 2, 6, 10 = 0.05 mm; 4 = 0.4 mm; 5, 9 = 0.2 mm.

interior border of each pseudolabia. A pair of amphids located on the base of pseudolabia. Two pairs of subdorsal and two pairs of subventral papillae surrounded the pseudolabia. Buccal capsule funnel-shaped, laterally compressed, narrowing posterior in dorsoventral view, almost straight-sided in lateral view. Cervical papillae situated at margin of cephalic and cervical regions. Cervical papillae cylindrical, rounded at outer margin with a central, needle-like projection. Lateral alae hypertrophied, origin from the base of pseudolabia, narrows toward posterior end in male and vulva region in female. Esophagus clearly divided into short anterior muscular part and long posterior glandular part. Nerve ring located at middle level of muscular esophagus. Excretory posterior to nerve ring.

Male ($n=1$). Body length 17.86 mm, 144 wide at level of posterior end of pharynx. Head width 120. Buccal cavity 36 wide in lateral view; 80 at proximal margin, 20 at distal margin in dorso-ventral view; 48 deep. Esophagus 4.76 mm long, anterior muscular esophagus 490 long. Cervical papillae 98, nerve ring 294 and excretory pore 368 from anterior end, respectively. Spicules unequal and dissimilar. Right spicule 396 long, its distal end bended dorsally and expanded slightly (Fig. 10). Left spicule 1.32 mm long, with a pointed distal end. Gubernaculum irregular-shaped, 48 long. Caudal alae with longitudinal striations on ventral surface and transverse striation on dorsal surface. Ventral surface of caudal region with prominent longitudinal ridges. Tail curved ventrally, 336 long, with a rounded tip. Caudal region with 4 pairs of symmetrically arranged pedunculate precloacal papillae, 2 pairs of symmetrically arranged pedunculate postcloacal papillae, and one single median papilla located just anterior to cloaca. Five pairs of sessile papillae located near tail tip.



Figs 11 – 14. SEM of *Paraspiralatus sakeri* Gibbons, Nicholls & Bailey 2004. 11. Cephalic extremity, en face view. 12. Pseudolabia, en face view. 13. Cephalic end of female, dorsoventral view. 14. Anterior end of female, lateral view. Cp. Cephalic papilla. La. Lateral ala. Pl. Pseudolabia. St. Small tooth. Scale bars: 11 = 40 μm, 12 = 30 μm, 13 = 75 μm, 14 = 100 μm.

Female (n = 3). Body length 23.88 – 24.47 (24.27) mm, 169 – 181 (175) wide at the level of posterior end of pharynx. Head width 121 – 145 (133). Buccal cavity 33 wide in lateral view; 80 at proximal margin, 10 at distal margin in dorsoventral view; 48 deep. Esophagus 6.60 – 6.99 (6.80) mm long, Muscular esophagus 485 – 631 long. Cervical papillae 96 – 121 (107), nerve ring 284 – 319 (299) and excretory pore 368 – 412 (391) from anterior end, respectively. Vulva located at middle level of body, 10.68 – 12.14 (11.49) mm from anterior end. Uterus divides 0.93 – 1.05 (1.00) mm from proximal end. Tail 19 – 27 (24) long, with rounded tip, without spines. Eggs 36 – 48 (41) long, 19 – 27 (24) wide, thick-walled and embryonated.

Type host. *Bubo bubo* (Linnaeus).

Site of infection. Buccal cavity and stomach.

Type locality. Beijing, China.

Prevalence and intensity. 2 infected / 2examined; 5 specimens.

Holotype male (HBNU-1126). Paratype female (HBNU-1127); paratypes 2 females (HBNU-1128).

Etymology. The species name refers to its geographic location (Beijing).

Remarks. Gibbons *et al.* (2004) established genus *Paraspiralatus* for *Paraspiralatus sakeri* collected

Table 1. Comparative chart of *Paraspiralatus beijingensis* sp. nov. with *P. sakeri*.

	Paraspiralatus beijingensis sp. nov.		*Paraspiralatus sakeri*	
	Male (mm)	Female (mm)	Male (mm)	Female (mm)
Length of body	17. 86	23. 88 – 24. 47	16. 04 – 17. 40	23. 06 – 23. 86
Lenght of esophagus	4. 76	6. 60 – 6. 99	5. 38 – 5. 65	5. 98 – 6. 34
Nerve ring*	0. 294	0. 284 – 0. 319	0. 256 – 0. 312	0. 260 – 0. 344
Cervical papillae*	0. 098	0. 096 – 0. 121	0. 076 – 0. 088	0. 088 – 0. 104
Excretory pore*	0. 368	0. 368 – 0. 412	0. 300 – 0. 360	0. 356 – 0. 416
Caudal length	0. 336	0. 019 – 0. 027	0. 240 – 0. 304	0. 280 – 0. 304
Vulva*		10. 68 – 12. 14		10. 53 – 11. 33
Eggs		0. 036 – 0. 048 ×		0. 042 – 0. 044 ×
		0. 019 – 0. 027		0. 026 – 0. 027
Left spicule	1. 32		1. 27 – 1. 47	
Right spicule	0. 396		0. 335 – 0. 390	
Distal end of right spicule	Bended dorsally and expanded slightly		Straight and bluntly pointed	
Gubernaculum	Irregular in shape		Irregular in shape	
Caudal papillae pattern**	8 + 4 + 1		8 + 4 + 0	

* Distance from anterior end. ** Precloacal + postcloacal + single median.

from saker falcons, *Falco cherrug* Gray in Saudi Arabia. They considered that the genus *Paraspiralatus* can be differentiated from the genus *Spiralatus* in having following features: cephalic vesicle absent; pseudolabia present; the shape of the buccal capsule cylindrical in *Spiralatus*, funnel-shaped in *Paraspiralatus*; the absence of spines on the female tail and being oviparous not viviparous.

The present species belongs to the genus *Paraspiralatus* in the absence of cephalic vesicle, presence of pseudolabia, and in having funnel-shaped buccal capsule. The new species very resembles the type and only species, *P. sakeri* Gibbons, Nicholls, Bailey and Samour, 2004, by combinatorial features such as the body size, the length of spicules, the position of vulva, the eggs size, and so on, but differs from the latter in having single median papilla anterior to cloaca, whereas it lacks in *P. sakeri*, and in the shape of right spicule (right spicule with bended and expanded distal end in the new species instead of right spicule with straight and bluntly pointed distal end in *P. sakeri*) (Table 1).

Order Spirurida Diesing, 1861
Superfamily Aproctoidea Yorke and Maplestone, 1926
Family Aproctidae Yorke & Maplestone, 1926
Genus *Aprocta* Linstow, 1883

3. 2 *Aprocta noctuae* Spaul, 1927 (Figs 15 – 31)

General. Body cylindrical, with rounded ends. Cuticle with fine transverse striations. Cephalic end with four outer and four inner submedian papillae and a pair of amphids. Mouth oval. Buccal cavity small. Esophagus simple and short, not divided into two parts. Nerve ring located at anterior part of esophagus; excretory pore posterior to nerve ring; cervical papillae rounded with a small pine-like projection, located near the level of the excretory pore, arranged slightly asymmetrically in male and symmetrically in female.

Male (n = 2). Body length 12. 62 – 13. 10 (12. 86) mm. Maximum width 440 – 490 (460). Esophagus 1. 26 – 1. 36 (1. 31) mm long. Nerve ring 130 – 150 (140) from anterior end; excretory pore 320 – 340 (330) from anterior end. Left cervical papillae 320 from anterior end, right cervical papillae 340 from anterior end. Tail rounded, 120 long. One medium precloacal papilla and a pair of postcloacal papillae. Spicules equal, 160 – 170 (170) long, their proximal end with spongy, chitinized appendages.

Female (n = 5). Body length 24. 76 – 27. 87 (26. 35) mm. Maximum width 730 – 780 (740). Esophagus 1. 26 – 1. 46 (1. 35) mm long. Nerve ring 170 – 220 (190), excretory pore 280 – 290 (290) and cervical papillae 270 – 290 (280) from anterior end, respectively. Vulva 520 – 640 (600) from anterior end. Eggs oval, with thin shell, 70 – 80 (80) long, 30 – 40 (40) wide, containing fully formed larvae.

Host. *Otus scops* (Linnaeus).

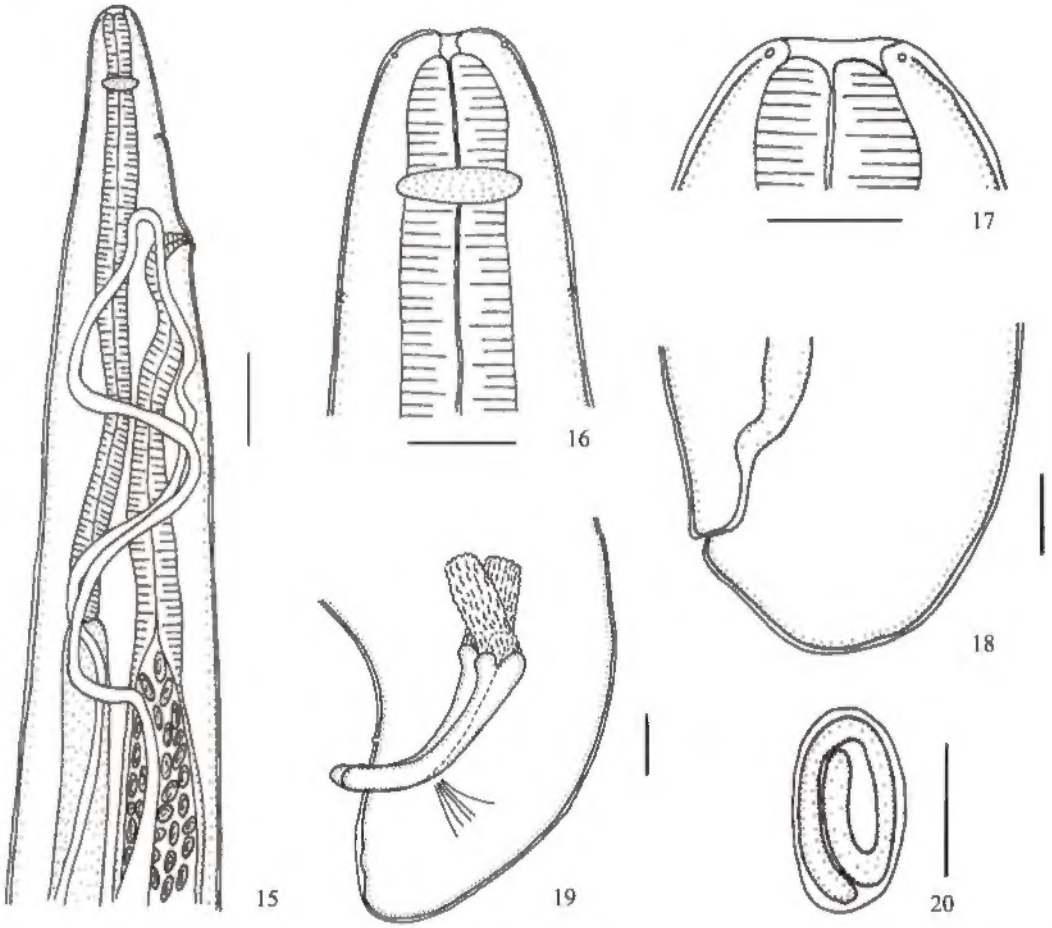
Site of infection. Body cavity

Locality. Beijing, China.

Prevalence and intensity. 1 infected / 8 examined; 11 specimens.

Voucher specimens. 1 male (HBNU-1129); 5 females (HBNU-1130).

Remarks. *Aprocta noctuae* was described by Spaul (1927) collected from *Athene noctua* in Morocco. Chabaud (1951) collected a species of *Aprocta* from same host which differs from the original description of *Aprocta noctuae*. After examination of specimens in the British Museum, however, Chabaud (1951) found

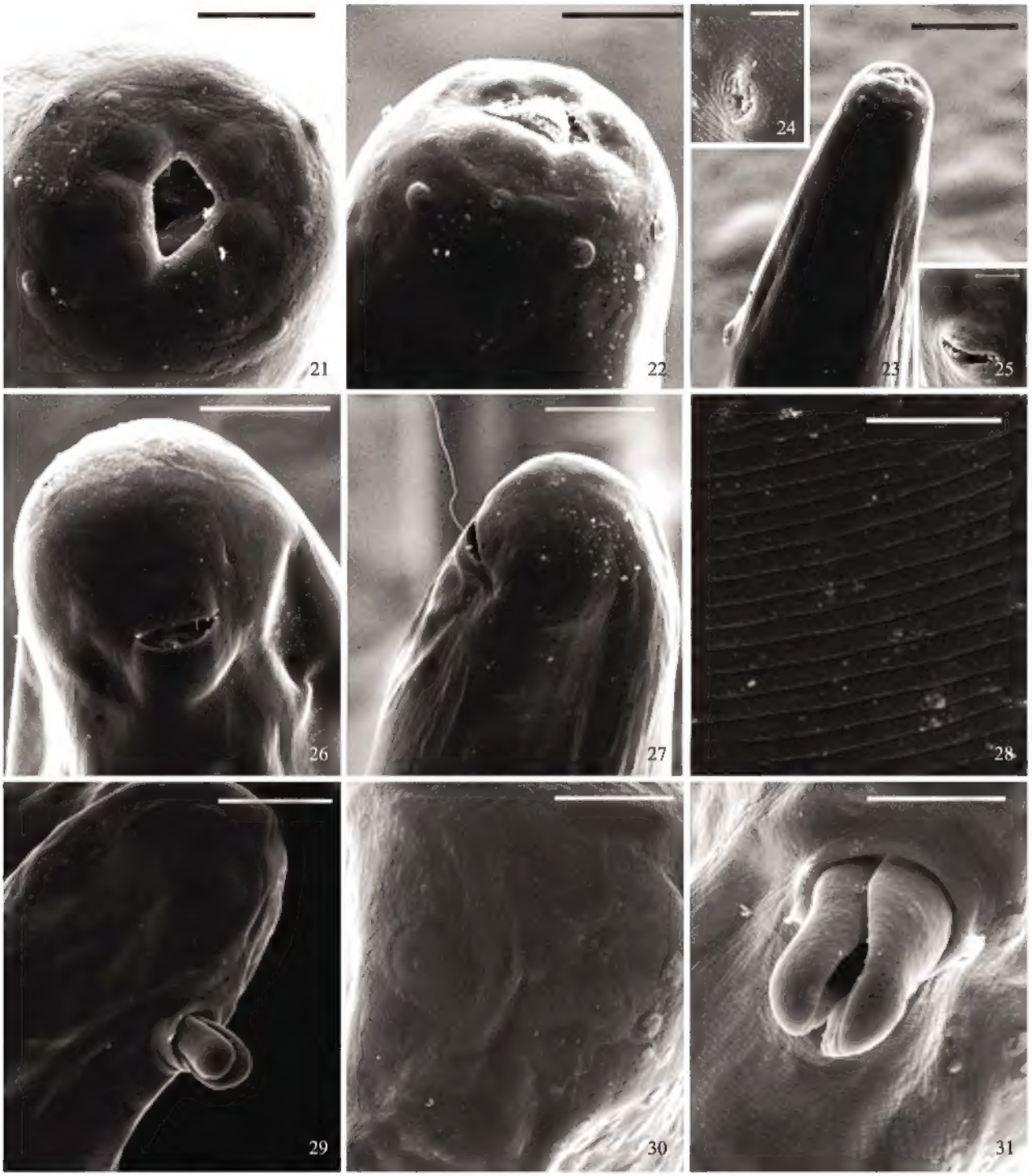


Figs 15 – 20. *Aprocta noctuae* Spaul, 1927. 15. Anterior end of female. 16. Anterior end of female. 17. Cephalic extremity of female. 18. Posterior end of female. 19. Posterior end of male. 20. Egg. 15, 17 – 19. Lateral view. 16. Dorsal view. Scale bars: 15 = 0.2 mm; 16 = 0.1 mm; 17 – 20 = 0.05 mm.

many inaccuracies in the original description and made corrections (Sonin, 1966).

Oshmarin (1950) described a nematode species collected from the abdominal cavity of *Otus sunia* in the Far East and named it *Lissonema spongispiculata* (*Lissonema spongispiculata* is now considered as a synonym of *Aprocta noctuae*). The morphology of *Lissonema spongispiculata* is agreed with *Aprocta noctuae* Spaul, 1927 except the spicules length and spongy, chitinized formation on proximal end of spicules. But these differences were considered without specific importance.

The present specimens agree with the description of Chabaud (1951) in general. However, SEM observation was made for the first time and revealed some differences. Firstly, the cephalic papillae consisting of four inner and four out papillae whereas just four cephalic papillae was described by Chabaud (1951). Secondly, SEM observation showed that cuticle with fine transverse striations which was not observed under the light microscopy. Cuticle smooth or with transverse striations usually was regarded as an important morphological character that is of specific importance of this group. However, the fine transverse striations were not easily observed by light microscopy. Therefore, the application of SEM may solve this confusion, and provide more reliable diagnostic characters for specific identification of this genus. This species is first report from China.



Figs 21 – 31. SEM of *Aprocta noctuae* Spaul, 1927. 21. Cephalic extremityof female, en face view. 22. Anterior extremity of female. 23. Anterior end of female. 24. Vulva. 25. Excretory pore. 26. Posterior end of female. 27. Posterior end of female. 28. Transverse striation, anterior end of body. 29. Posterior end of male. 30. Posterior extremity of male. 31. Spicules. 22 – 23, 27, 29. Lateral view. 26, 30 – 31. Ventral view. Scale bars: 21, 29 = 40 μm; 22 = 50 μm; 23 = 150 μm; 24 = 6 μm; 25, 31 = 20 μm; 26 = 70 μm; 27 = 80 μm; 28 = 10 μm; 30 = 22 μm.

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北京猛禽两种旋尾类寄生线虫的报道（线虫纲，旋尾目）

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摘 要 报道寄生于北京猛禽的2种旋尾类线虫，其中一种为新种，另一种为中国新纪录种。作者分别对其做了光镜和电镜观察。北京副旋翼线虫，新种 *Paraspiralatus beijingensis* sp. nov. 采自于雕鸮的口腔和胃内，它与 *P. sakeri* Gibbons, Nicholls & Bailey, 2004 的不同之处在于具有单个的肛前乳突，右交合刺远末端弯向背侧并稍微膨大而 *P. sakeri* 的交合刺远末端是直的，不膨大，呈钝尖形。纵纹腹小鸮无肛线虫 *Aprocta noctuae* Spaul, 1928 采自红角鸮的体腔。本次所观察标本在形态上，如交合刺的长短和形状，尾乳突的数目和排列，阴门的位置，卵的大小等，都与前人对 *A. noctuae* 的描述一致。但是电子扫描电镜结果显示，*A. noctuae* 的头端具有8个头乳突而不是4个，线虫角质层具有精细的横纹。*A. noctuae* 为我国新纪录种。标本保存于河北师范大学生命科学学院。

关键词 猛禽，线虫，副旋翼属，无肛属，新种.
中图分类号 Q959.172.2

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